

# Forensic Science

Spring 2007      CC 30. 07  
Upper Tier Core Course

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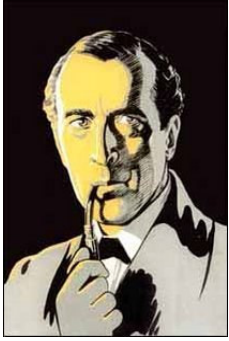
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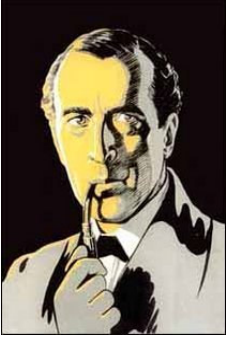




# What is Forensic Science?

- It is the application of science to the law
- In criminal cases forensic scientists are involved in the search for and examination of physical traces which might be useful for establishing or excluding an association between someone suspected of committing a crime and the scene of the crime or victim.

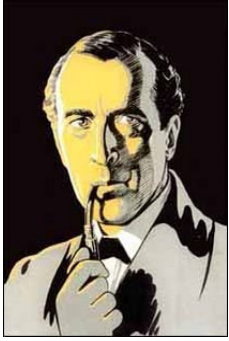




# Forensic Science

- In its broadest definition, forensic science is the application of science to criminal and civil laws.
- Forensic science owes its origins to individuals such as Bertillon, Galton, Lattes, Goddard, Osborn, and Locard, who developed the principles and techniques needed to identify or compare physical evidence.



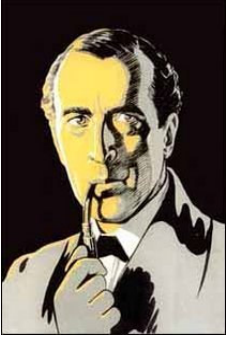


# Eureka !

## The First Scientific Investigation

- **Archimedes** (287-212 BC) – Father of Forensic Science
- He discovered that a crown was not made of gold, (as it was falsely claimed) by its density and buoyancy

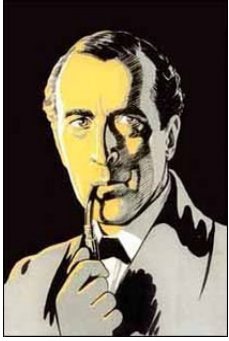




Next forensic science application  
was by **Soleiman**,  
an Arabic merchant of the 7th  
century

He used fingerprints  
as a proof of validity  
**between** debtors and lenders

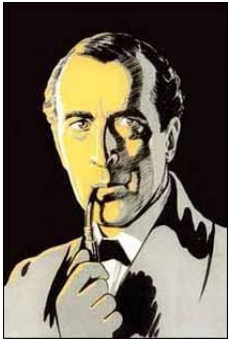




# Other Forensic Science evidences - 1

- In the 700s, the Chinese also used the fingerprint concept.
- In the 1000s, Quintilian, a prosecutor in the Roman courts, used a similar method to solve murders.

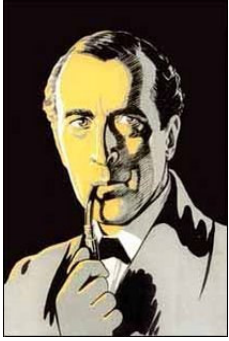




# Other Forensic Science evidences - 2

- The first document that mentions the use of Forensics in legal matters is the book *Xi Yuan Ji Lu* (translated as “Collected Cases of Injustice Rectified”) written in 1248 by Chinese author Song Ci.



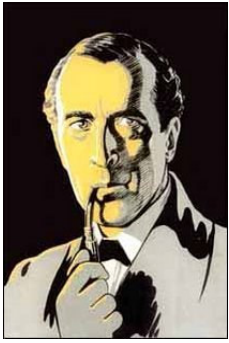


# Forensic Science Widespread in 16th century Europe - 3

- **Medics** began to use their knowledge to investigate the cause of death.
- **Ambrose Paré, a French army surgeon, two Italian surgeons, Fortunato Fidelis and Paolo Zacchia** were some of the pioneers in this field.





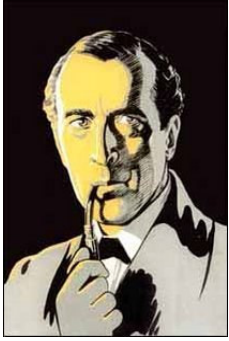


# Forensic Science – 4

## 16<sup>th</sup> Century Written Records

- “A Treatise on Forensic Medicine and Public Health” by the French physician Fodéré
- “The Complete System of Police Medicine” by the German medic Johann Peter Franck and
- the first dissertation on systematic document examination published by François Demelle of France.
- In 1686, Marcello Malpighi, a professor of anatomy at the University of Bologna, identified the fingerprint method.



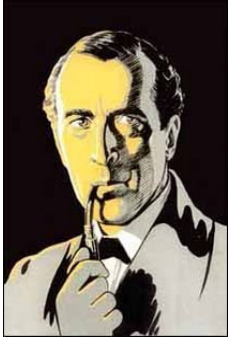


# Forensic Science – 5

## 18<sup>th</sup> Century

- Groundbreaking work in Forensics. Swedish chemist Carl Wilhelm Scheele and German chemist Valentin Ross
- England also solved a number of murder cases using forensic science.
- In the year 1784 in Lancaster, John Toms was convicted of murder, when a torn bit of a newspaper in a gun was found matching a leftover paper in his pocket.



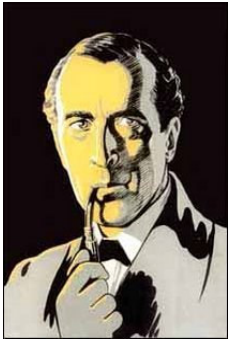


# Forensic Science – 5

## 19<sup>th</sup> Century

- *The following made history in forensic science*
- Scholars like Thomas Bewick, an English naturalist
- Spanish professor of medicinal/forensic chemistry Mathiew Orfila
- John Evangelist Purkinji, professor of anatomy at the University of Breslau Eugène
- François Vidocq established the first detective force, the Sûreté of Paris.



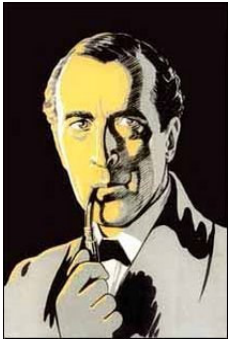


# Forensic Science – 6

## 20<sup>th</sup> Century

- *Arthur Conan Doyle wrote the first Sherlock Holmes case in Beeton's Christmas Annual of London*
- *Federal Bureau of Investigation in the United States*
- *At present, approximately 350 public crime laboratories operate at various levels of government—federal, state, county, and municipal.*

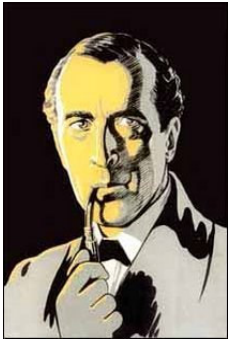




# Forensic Science - History

- Mathieu Orfila—the father of forensic toxicology.
- Alphonse Bertillion—devised the first scientific system of personal identification in 1879.
- Francis Galton—conducted the first definitive study of fingerprints and their classification.
- Leone Lattes—developed a procedure to determine blood type from dried bloodstains.
- Calvin Goddard—used a comparison microscope to determine if a particular gun fired a bullet.
- Albert Osborn—developed the fundamental principles of document examination.

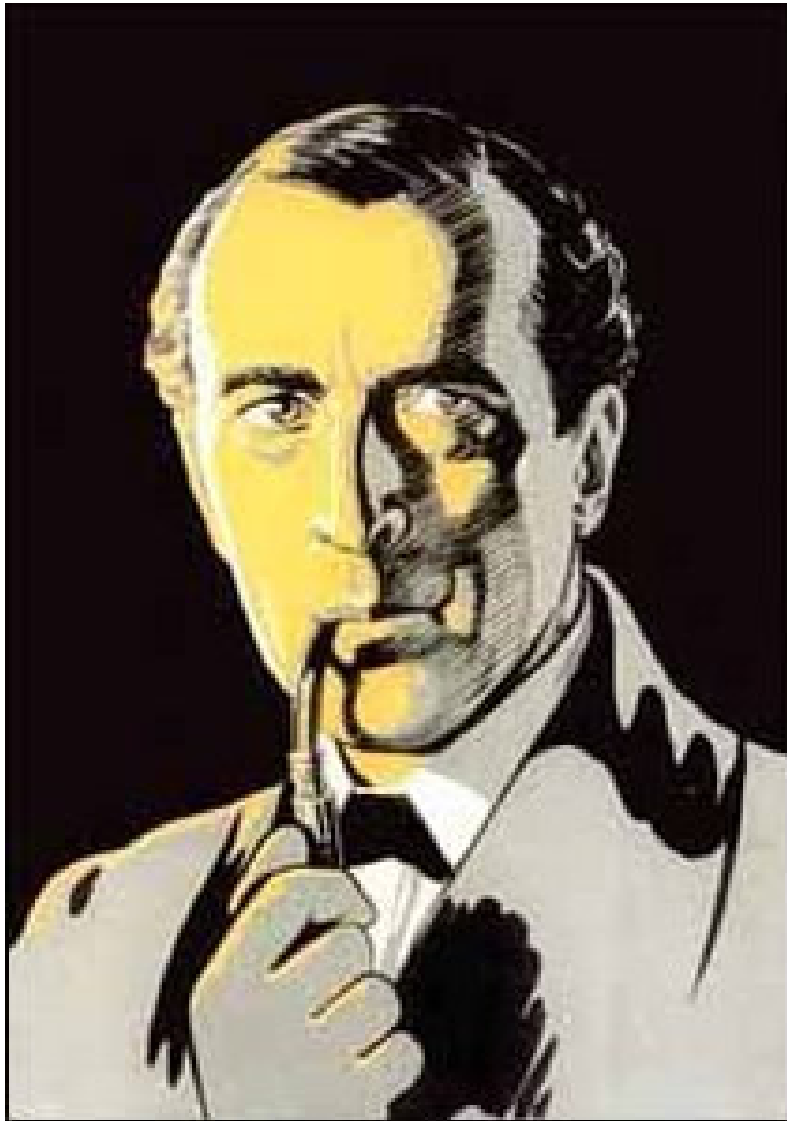




# Forensic Science – History- contd.

- Walter McCrone—utilized microscopy and other analytical methodologies to examine evidence.
- Hans Gross—wrote the first treatise describing the application of scientific principles to the field of criminal investigation.
- Edmond Locard—incorporated Gross’ principles within a workable crime laboratory.
- Locard’s Exchange Principle—states that when a criminal comes in contact with an object or person, a cross-transfer of evidence occurs.





# Sherlock Holmes

*series between  
1887 – 1893*

*Fictional character  
who provided the  
world with scientific  
ideas and techniques  
for solving crimes*



# Sir Arthur Conan Doyle

*(1859-1930)*

*Physician &  
Fiction Writer*

*Adventures of  
Sherlock Holmes –  
Series (1887-1893)*

*1906 – Became the first  
forensic investigator*





# Sherlock Holmes

## *Bronze Bust in Switzerland*





**Dr. John Watson  
&  
Sherlock Holmes  
( *Movie Characters* )**

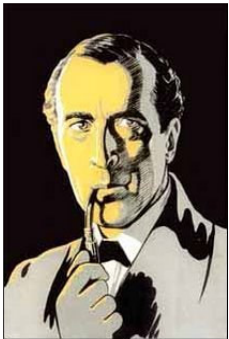
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# Elementary My Dear Watson !!

**Watson's statement about**

**Holmes's knowledge of geology**

*“Practical but limited. Tells at a glance different soils from each other and is able to recognize splashes on his trousers from different parts of London”.*





**Hans Gross**  
**(1847-1915)**

*Founder of*  
**Scientific Criminal**  
**Investigation**

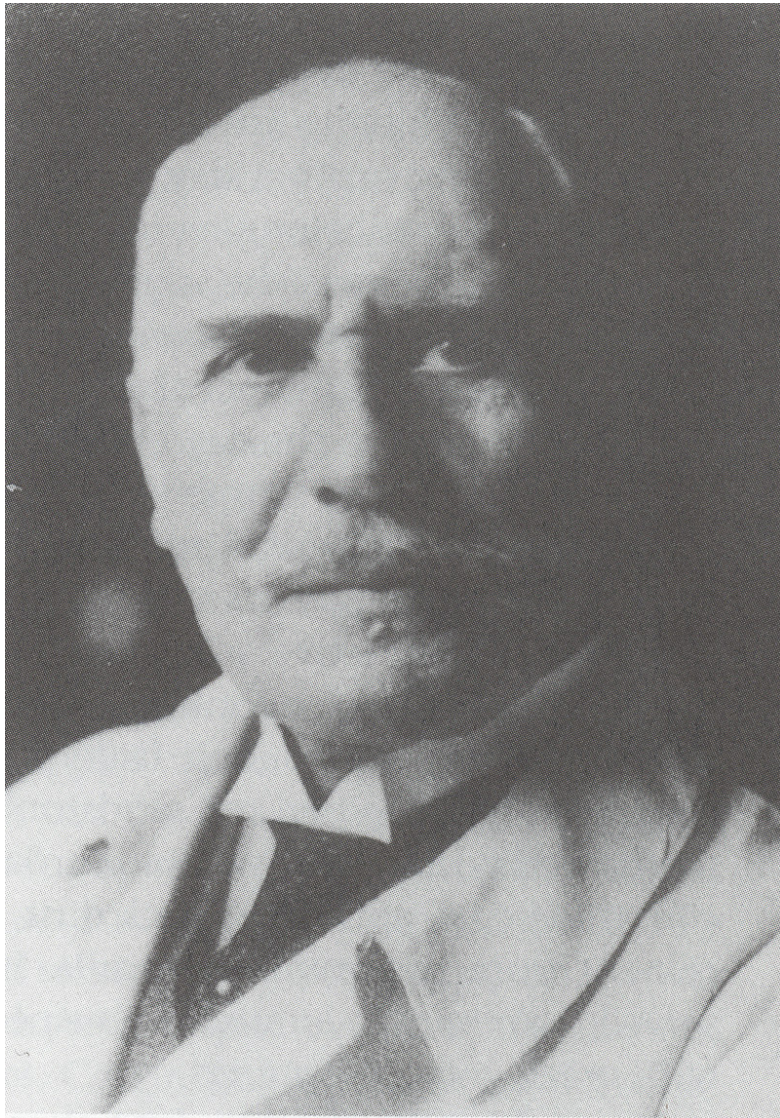
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# **George Popp**

***German Chemist &  
Forensic Scientist***

***1904 – First  
Investigator of  
Earth Materials***





# Edmond Locard

## *French Forensic Geologist*

*First to establish a police criminal  
lab in France*

*1910 - Established the  
“Exchange Principle”  
the fundamental tenet  
of Forensic Geology*





**Agatha Christie**  
**(1890-1976)**

*The Well known  
Detective  
Novel Writer*



**Mathieu Orfila –**  
(1787 – 1853) Spanish  
*"Father of  
Toxicology"*

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1807, he attended courses in  
medicine at the University of  
Valencia and chemistry at the  
University of Barcelona.  
He won a scholarship to the  
University of Madrid  
to study chemistry and  
mineralogy, but instead  
went to Paris  
Buried - March 16, 1853,  
somewhere in France.





# Alphonse Bertillon

(1853 – 1914)

**Father**

**of**

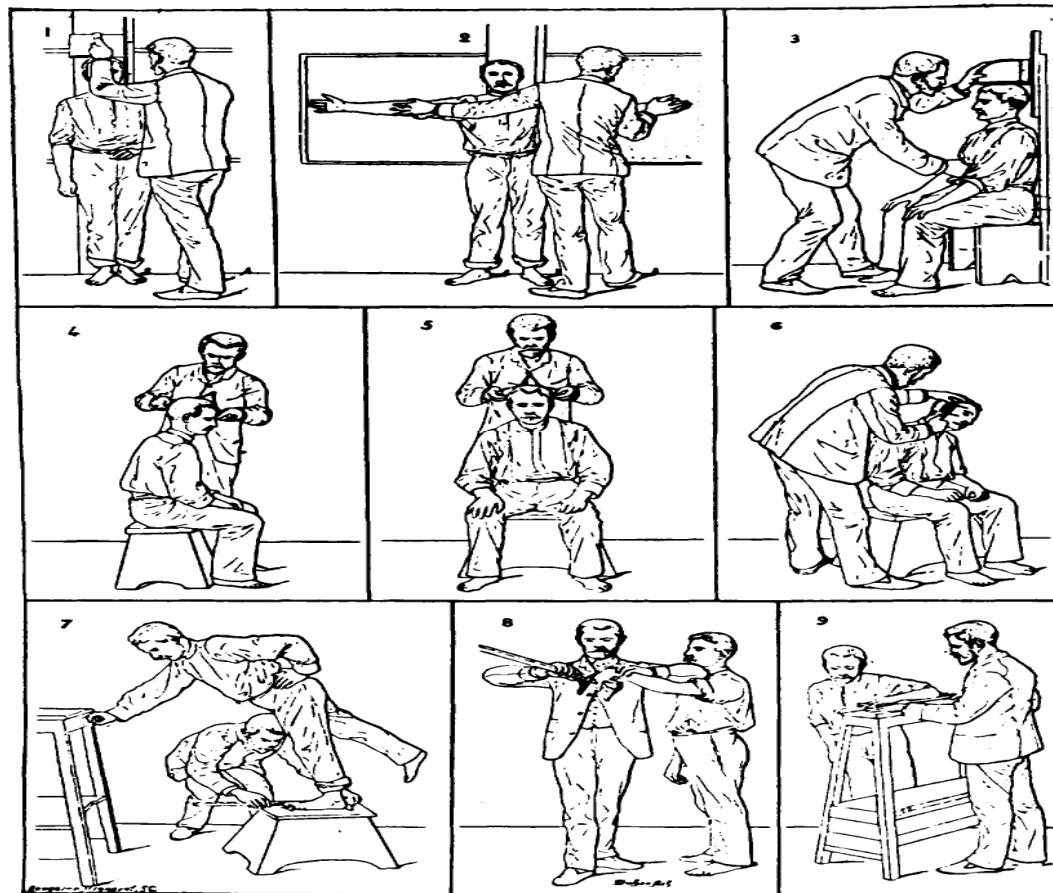
**Criminal Investigation**

Devised the first scientific system  
of Personal identification



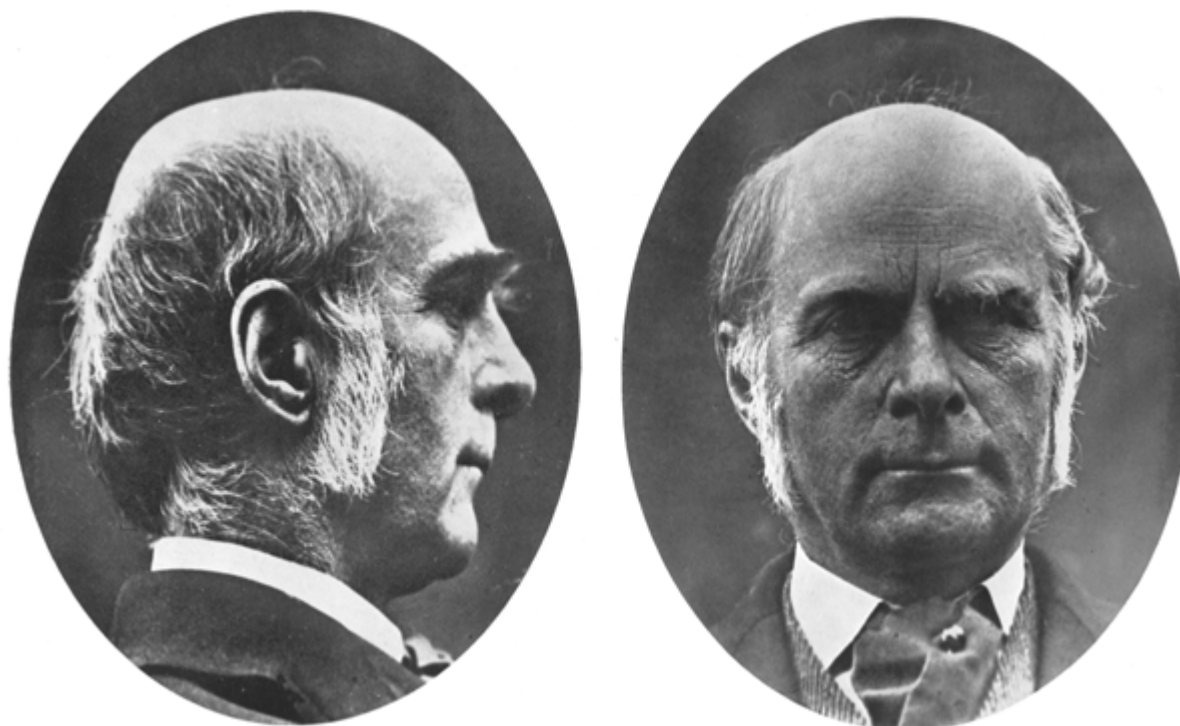


RELEVÉ  
DU  
SIGNALEMENT ANTHROPOMÉTRIQUE



1. Taille. — 2. Envergure. — 3. Buste. —  
4. Longueur de la tête. — 5. Largeur de la tête. — 6. Oreille droite. —  
7. Pied gauche. — 8. Médius gauche. — 9. Coudée gauche.





*Francis Galton*

**Sir Francis Galton F.R.S. 1822-1911**

1892 – First to develop techniques of Finger Printing

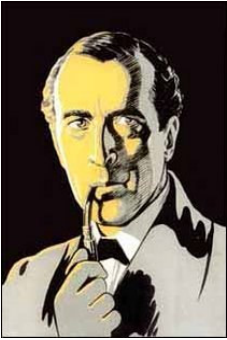
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# Prof. Leone Lattes

(1887 – 1954)

## Blood grouping techniques

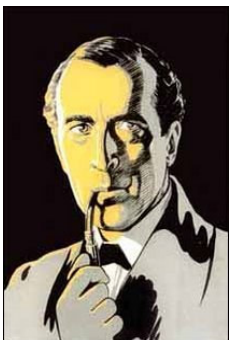
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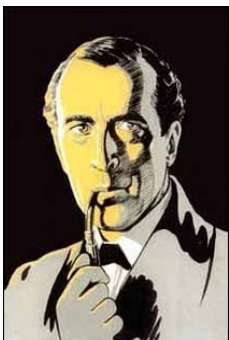


# Calvin Goodard

(1891 - 1955)

## Microscopic examination of Fire Arms Bullet Markings



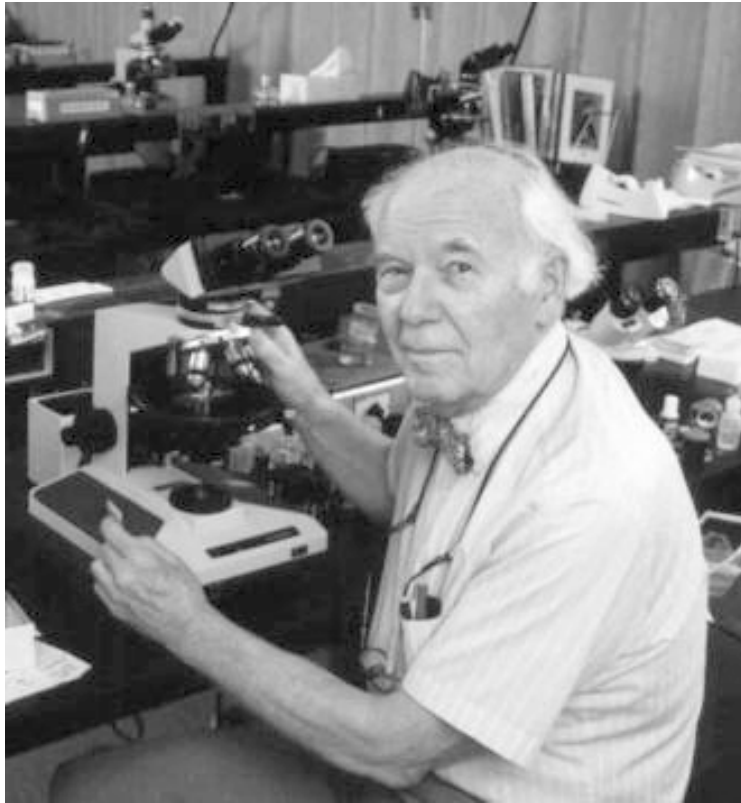


# Osborn S. Albert

(1858 – 1946)

## Acceptance of documents as scientific evidence





# Walter McCrone (1916 – 2002) Microscopist

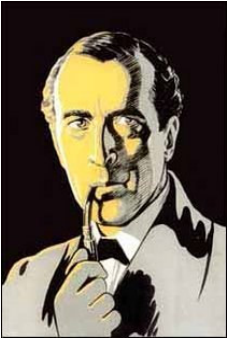
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# The Crime Lab

- **The development of crime laboratories in the United States has been characterized by rapid growth accompanied by a lack of national and regional planning and coordination.**
- **At present, approximately 350 public crime laboratories operate at various levels of government—federal, state, county, and municipal.**



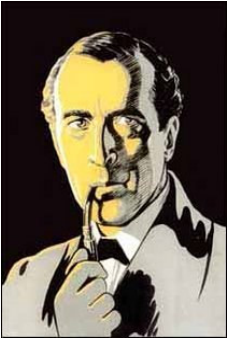




## **The ever increasing number of crime laboratories is partly due to**

- Supreme Court decisions in the 1960s responsible for police placing greater emphasis on scientifically evaluated evidence.**
- Crime laboratories inundated with drug specimens due to accelerated drug abuse.**
- The advent of DNA profiling.**

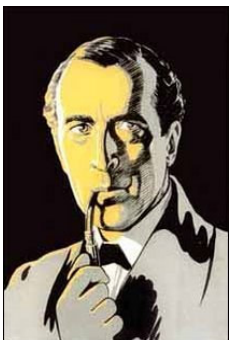




# Crime Lab Technical Support

- **Assigned to five basic services.**
  - **Physical Science Unit:**  
incorporates the principles of chemistry, physics, and geology to identify and compare physical evidence.
  - **Biology Unit:**  
applies the knowledge of biological sciences in order to investigate blood samples, body fluids, hair, and fiber samples.
  - **Firearms Unit:**  
investigates discharged bullets, cartridge cases, shotgun shells, and ammunition.

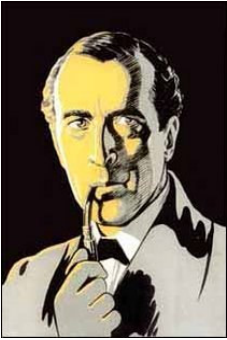




# Crime Lab Technical Support - Continued

- **Document Unit:**  
provides the skills needed for handwriting analysis and questioned-document issues.
- **Photographic Unit:**  
applies specialized photographic techniques for recording and examining physical evidence.
- **Optional services:**  
toxicology, fingerprint analysis, voiceprint analysis, evidence collection, and polygraph administration

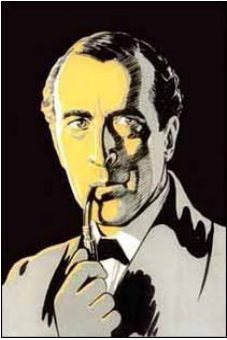




# Skills of a Forensic Scientist

- skilled in applying the principles and techniques of the physical and natural sciences to the analysis of the many types of evidence that may be recovered during a criminal investigation.
- may also provide expert court testimony.
- Serve as an expert witness: an individual whom the court determines possesses knowledge relevant to the trial (not expected of the average person).

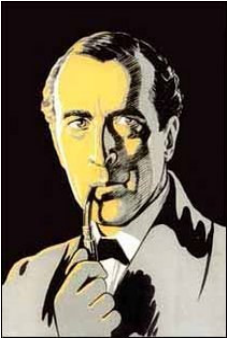




# Skills of a Forensic Scientist – Contd.

- **The expert witness is called on to evaluate evidence based on specialized training and experience that the court lacks the expertise to do.**
- **The expert will then express an opinion as to the significance of the findings.**
- **Forensic scientists also participate in training law enforcement personnel in the proper recognition, collection, and preservation of physical evidence.**

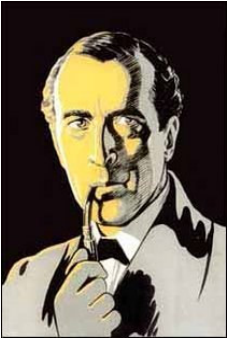




# The *Frye* Standard

- The *Frye v. United States* decision set guidelines for determining the admissibility of scientific evidence into the courtroom.
- To meet the *Frye* standard, the evidence in question must be “generally accepted” by the scientific community.

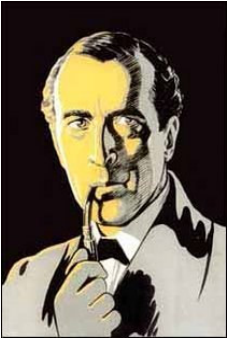




## *Frye* Not Absolute

- However, in the 1993 case of *Daubert v. Merrell Dow Pharmaceutical, Inc.*, the U.S. Supreme Court asserted that the *Frye* standard is not an absolute prerequisite to the admissibility of scientific evidence.
- Trial judges were said to be ultimately responsible as “gatekeepers” for the admissibility and validity of scientific evidence presented in their courts, as well as all expert testimony.



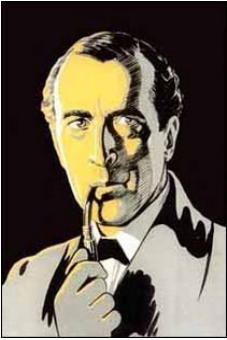


# ***The Daubert Criteria***

- In *Daubert*, the Supreme Court offered some guidelines as to how a judge can gauge scientific evidence:
  - 1) Whether the scientific technique or theory can be (and has been) tested.
  - 2) Whether the technique or theory has been subject to peer review and publication.
  - 3) The technique's potential rate of error.



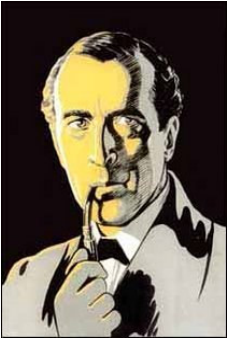




## **The *Daubert* Criteria – Contd.**

- 4) Existence and maintenance of standards controlling the technique's operation.**
- 5) Whether the scientific theory or method has attracted widespread acceptance within a relevant scientific community.**

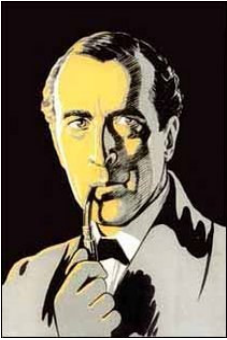




## Special Forensic Science Services

- A number of special forensic science services are available to the law enforcement community to augment the services of the crime laboratory.
- These services include forensic pathology, forensic anthropology, forensic entomology, forensic psychiatry, forensic odontology, computer science, and forensic engineering.

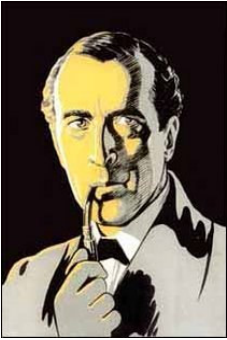




# Special Forensic Science Services - contd

- **Forensic Pathology involves the investigation of unnatural, unexplained, or violent deaths.**
  - **Forensic pathologists in their role as medical examiners or coroners are charged with determining cause of death.**
  - **The forensic pathologist may conduct an autopsy which is the medical dissection and examination of a body in order to determine the cause of death.**

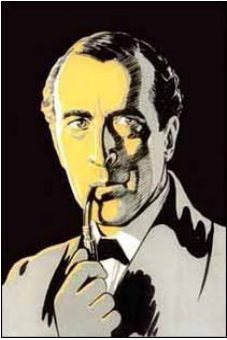




# Special Forensic Science Services - Contd

- After a human body expires there are several stages of death.
  - Rigor Morits
  - Livor mortis
  - Algor mortis

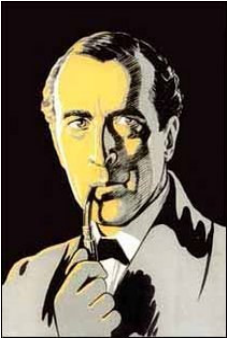




## Special Forensic Science Services - Contd

- **Rigor mortis** results in the shortening of muscle tissue and the stiffening of body parts in the position at death (occurs within the first 24 hours and disappears within 36 hours).

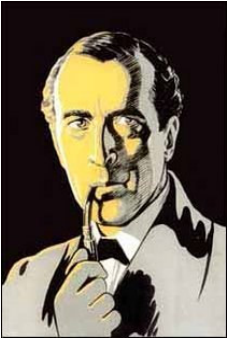




# Special Forensic Science Services - Contd

- **Livor mortis:** results in the settling of blood in areas of the body closest to the ground (begins immediately on death and continues up to 12 hours).

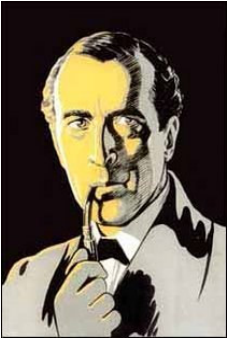




# Special Forensic Science Services - Contd

- **Algor mortis:** results in the loss of heat by a body (a general rule, beginning about an hour after death, the body loses heat by 1 to 1-1/2 degrees Fahrenheit per hour until the body reaches the environmental temperature).



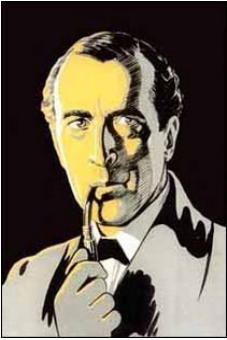


# Special Forensic Science Services - Contd

- **Forensic Anthropology** is concerned primarily with the identification and examination of human skeletal remains.
- **Forensic Entomology** is the study of insects and their relation to a criminal investigation, commonly used to estimate the time of death.
- **Forensic Psychiatry** is an area in which the relationship between human behavior and legal proceedings is examined.



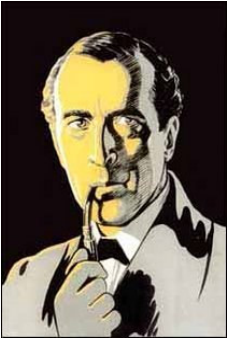




# Special Forensic Science Services - Contd

- **Forensic Odontology** involves using teeth to provide information about the identification of victims when a body is left in an unrecognizable state; also investigates bite marks.
- **Forensic Engineering** is concerned with failure analysis, accident reconstruction, and causes and origins of fires or explosions.
- **Forensic Computer Science** involves the examination of digital evidence.





# Special Forensic Science Services - Contd

- **Forensic Geology:** deals with the geological aspects of crime

